GEOLOGIC CHARACTERIZATION OF PARADISE LAKE

FLAGLER COUNTY, FLORIDA

By

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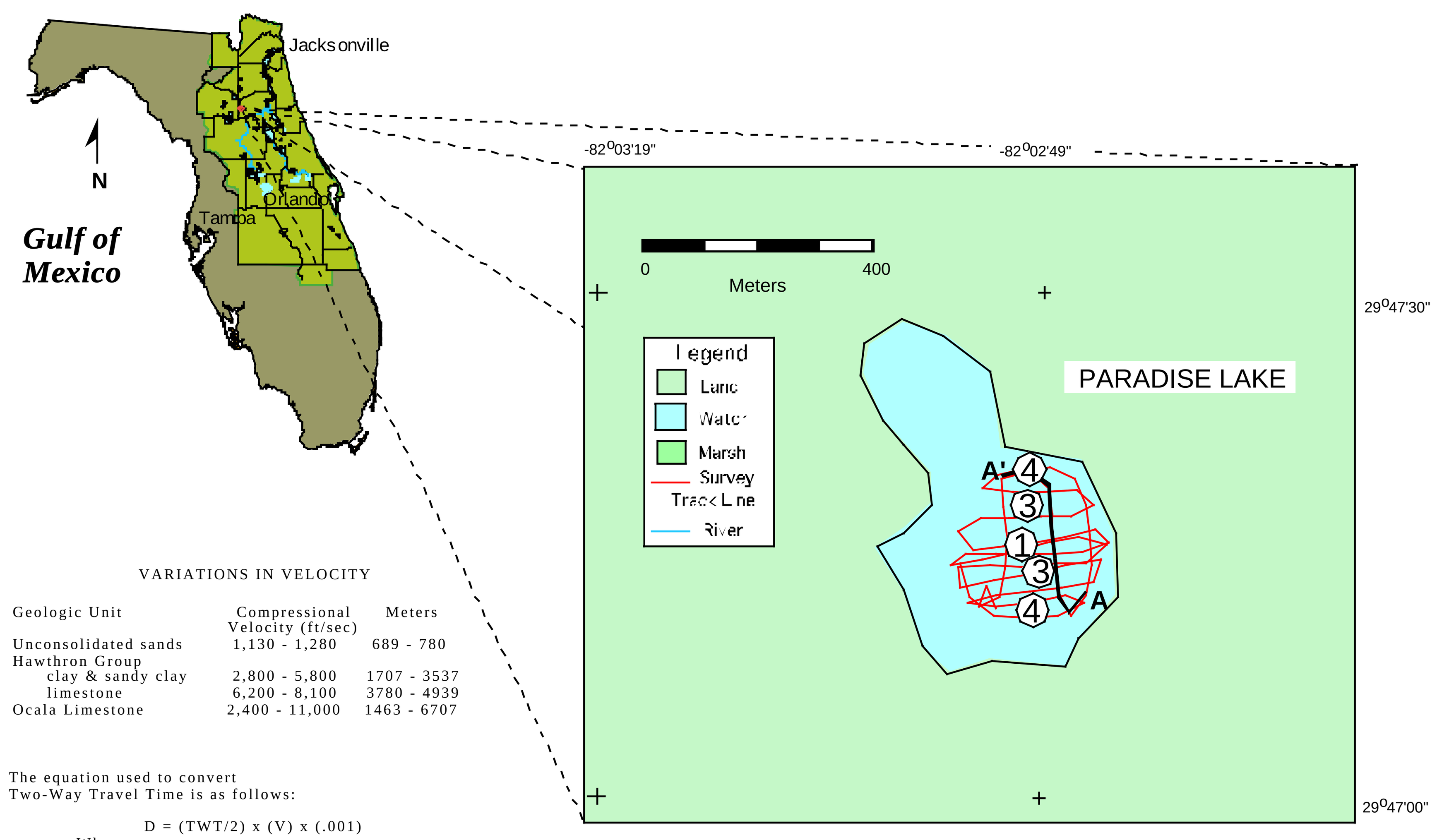
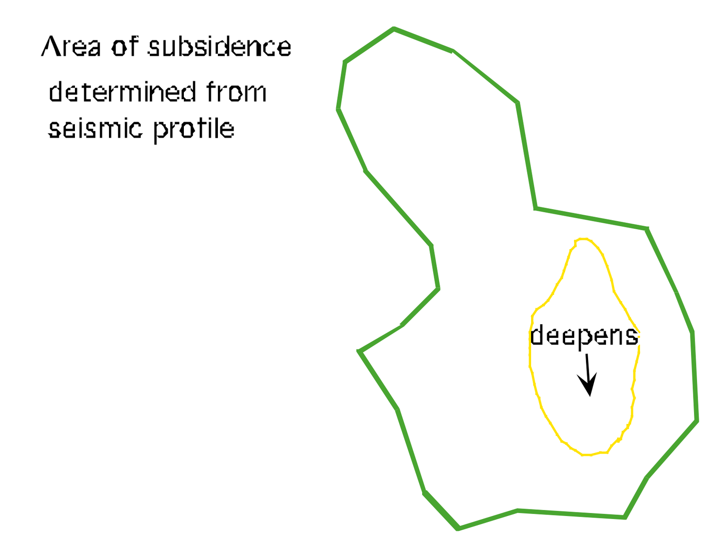




VARIATIONS IN VELOCITY

Geologic Unit	Compressional Velocity (ft/sec)	Meters
Unconsolidated sands	1,130 - 1,280	689 - 780
Hawthron Group		
clay & sandy clay	2,800 - 5,800	1707 - 3537
limestone	6,200 - 8,100	3780 - 4939
Ocala Limestone	2,400 - 11,000	1463 - 6707

The equation used to convert
Two-Way Travel Time is as follows:

$$D = (TWT/2) \times (V) \times (.001)$$

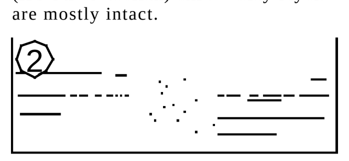
Where :

D = Depth in meters
TWT = Two Way Travel Time in milliseconds
V = Velocity

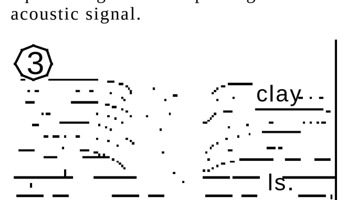
(1500 meters per second is used here)

EXPLANATION

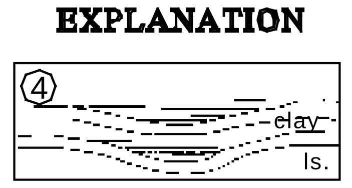
Undisturbed section, with or without upper non-reflective sand layer. Sand layer may show reflection where cross bedding from original deposition (fluvial or aeolian) exits. Clay layers are mostly intact.



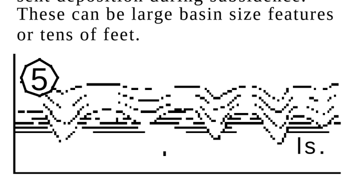
Undisturbed section with areas obscured by noise created by muck or aquatic vegetation dispersing the acoustic signal.



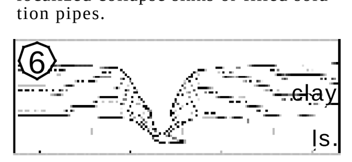
Horizontal reflectors continuous on either side of a central non-reflective zone. Horizontal layers bend downward towards the central zone. These features are representative of filled collapse sinks. The size may range from tens of meters to kilometers across a lake basin.



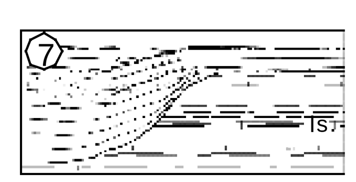
Low angle, subsidence depressions. Parallel reflectors are relatively intact. Horizontal reflectors onlap onto the subsided parallel reflectors and represent deposition during subsidence. These can be large basin size features or tens of feet.



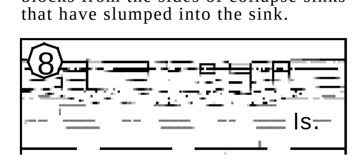
Numerous small features with high angle reflectors dipping toward their center. These features may represent localized collapse sinks or filled solution pipes.



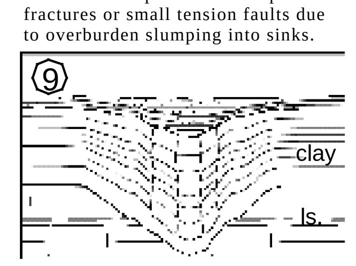
High-angle reflector with no overlying return. Represents a collapse sink that may be associated with a subsurface cavity. Walls are steep and typically less than 50 meters in diameter.



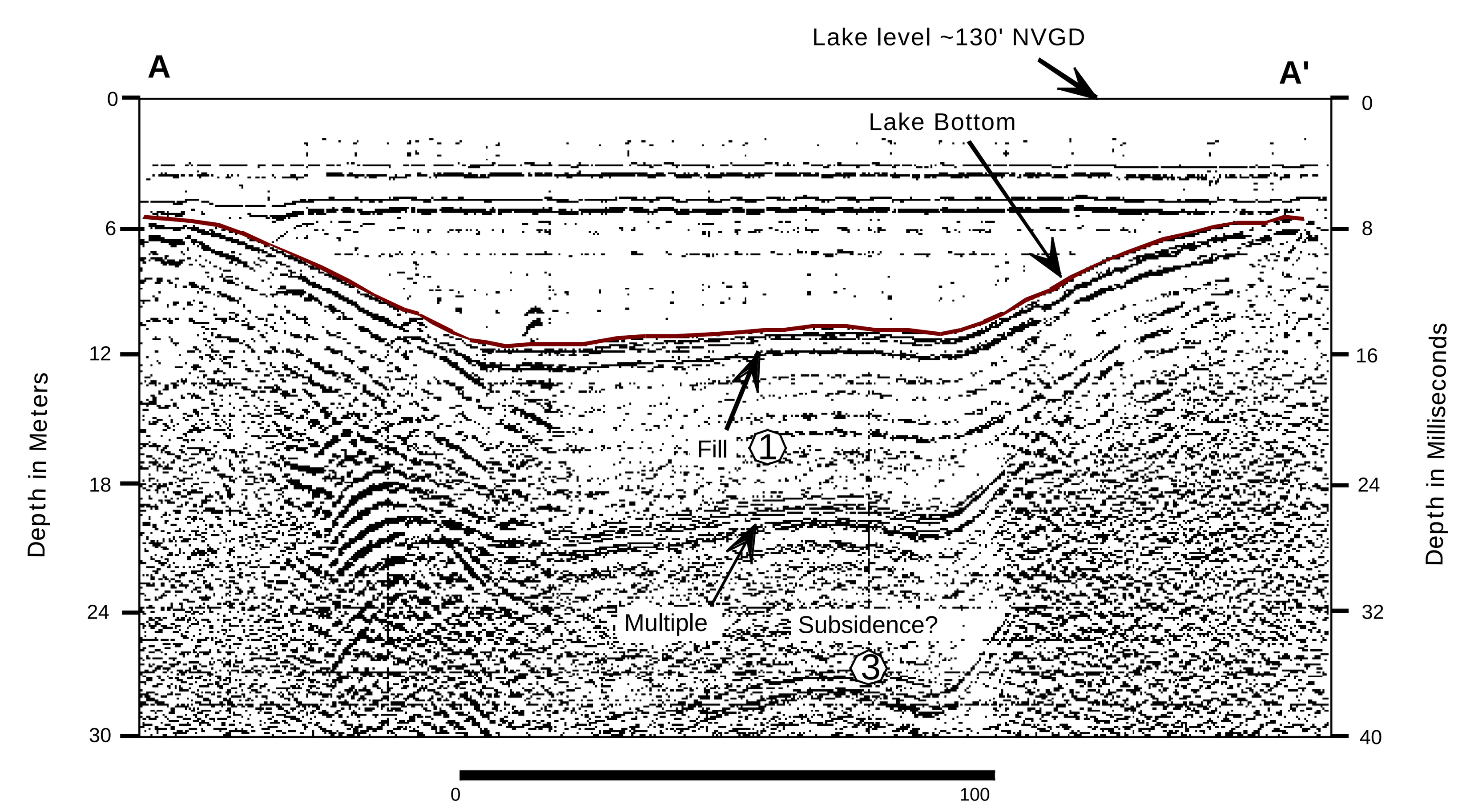
Mid- to high-angle parallel reflectors with indications of vertical displacement and rotation. Feature may be buried by overburden. Represents blocks from the sides of collapse sinks that have slumped into the sink.



Near vertical discontinuities through parallel, horizontal reflectors with little vertical displacement. Represents fractures or small tension faults due to overburden slumping into sinks.



Low- to mid-angle subsidence depressions. Parallel reflectors have undergone displacement and rotation, creating stress fractures and faulting within the depression. The subsidence may or may not be filled with overburden.



INTRODUCTION

The potential fliud exchange between lakes of northern Florida and the Floridan aquifer and the process by which exchange occurs is of critical concern to the St. Johns River Water Management District (SJRWMD). High-resolution seismic tools with relatively new digital technology were utilized in collecting geophysical data from > 40 lakes and rivers. The data collected shows the application of these techniques in understanding the formation of individual lakes and rivers, thus aiding in the management of these natural resources by identifying breaches or areas where the confining units are thin or absent between the water bodies, the Intermediate aquifer and the Floridian aquifer.

This study was a cooperative investigation conducted from 1993 to 1996 by the SJRWMD and U.S. Geological Survey Center for Coastal Geology (USGS). Since 1989 there have been technical and hardware advances in the digital acquisition of high-resolution seismic data. The primary objective of this cooperative was to test newly developed digital high-resolution single-channel marine seismic continuous-profiling-equipment (HRSP) and apply this technology to identify subbottom features that may enhance leakage from selected lakes and the St. Johns River. The target features include: (1) identifying evidence of breaches or discontinuities in the confining units between the water bodies and the aquifer, and; (2) identifying areas where the confining unit is thin or absent.

METHODS

In cooperation with SJRWMD the USGS acquired and upgraded a digital seismic acquisition system. The Elics Delph2 High-Resolution Seismic System was acquired with proprietary hardware and software running in real time on an Industrial Computer Corp. 486/33 PC. Hard-copy data was displayed on a gray scale thermal plotter. Digital data was stored on a rewritable Magneto-Optical compact disk. Navigation data was collected using a Trimble GPS or PLGR (Rockwell) GPS. GeoLink XDS mapping software was used to display navigation.

The acoustic source was the Huntec Model 4425 Seismic Source Module and a catamaran sled with an electromechanical device. Occasionally, an ORE Geopulse power supply was substituted for the Huntec Model 4425. Power was set at 60 joules or 135 joules depending upon conditions. An Innovative Transducers Inc. ST-5 multi-element hydrophone was used to detect the return acoustical pulse. This pulse was fed directly into the Elics Delph2 system for storage and processing.

Forty-four line-km of HRSP data was collected from Lake Disston. A velocity of 1500 meters per second (m/s) was used to calculate a depth scale for the seismic profiles. Measured site specific velocity data is not available for these sites.

These surveys were conducted in part to test the effectiveness of shallow-water marine geophysical techniques in the freshwater lakes of central Florida. Acquisition techniques were similar but modifications were necessary. Data quality varied from good to poor with different areas and varying conditions. As acquisition techniques improved so did data quality in general. In many areas an acoustic multiple masked much of the shallow geologic data.

Physiography

Lake Disston is in the extreme southwestern corner of Flalger County, Florida. The lake is located east of the southern tip of the Cresent City Ridge and northwest of the northern tip of the Deland Ridge. It is part of the Pamlico Terrace. Lake elevation at the time of the seismic survey was ~4.26 m (14 ft) NVGD. Lake Disston is oval shaped ~ 4.2 x 2.4 km with a of perimeter 28 km and the surface area 45.6 sq km. Average water depth during the survey was 1.5 to 1.8 m (5 - 6 ft). The lake is surrounded by a plain with ~20 ft average elevation and bordered on the north by marsh associated with Little Haw Creek and woodland to the south.

GEOLOGIC CHARACTERIZATION

Lake Disston is characterized by several seismic reflections. The subsidence to the east is a category 3 seismic character (Profile A-A'; Contour Maps; and Explanation), while the western part of the lake has several combined categories 3 and 9 (3,9). The 3,9 are small individual depressions described as fractured above and nonreflective below. Profile B-B' is an example of 4,9 with infill above and fracture below. Subsurface Profile C-C' shows that the large subsidence has had continuous filling with slower subsidence, allowing the depression to infill.

Logs from wells in the area have shown the depth to the top of the Ocala Limestone to be -9 to -18 m (-30 to -60 ft) NVGD. Not knowing the actual velocities of the substrate has not allowed us to absolutely pick this reflector. Using the geomtry of the units from the seismic profiles we have identified the confining layer (Hawthron Group?) and the top of the limestone (Ocala Limestone?), Profile B-B'.